

Patent  
Attorney Docket 4351

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Application No.: (not assigned) )  
Filed: (not assigned) )  
For: PLASMA FILM-FORMING APPARATUS )  
AND CLEANING METHOD FOR THE )  
SAME )

Pittsburgh, Pennsylvania

**PRELIMINARY AMENDMENT**

Box PATENT APPLICATION  
Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

This is a Preliminary Amendment to the application referenced above and filed simultaneously herewith.

Pursuant to the new rules regarding amendments, kindly amend the specification by amending the ABSTRACT OF THE DISCLOSURE on page 1 of the specification, the SUMMARY OF THE INVENTION appearing on pages 4 and 5 of the original specification, and the claims appearing on pages 12 and 13, as indicated hereinafter in the following pages in unmarked up form. A marked up version of the amendments to the specification and claims are attached by way of appendix to this amendment.

### **ABSTRACT OF THE DISCLOSURE**

A plasma film-forming apparatus which includes a film-forming chamber in which a substrate is arranged, a film-forming gas introducing pipe is connected to a supply source of a film-forming gas at its first end, a shower plate having numerous holes through which a second end of the film-forming gas introducing pipe communicates with the film-forming chamber, film-gas exciting means for exciting film-forming gas introduced through the shower plate into the film-forming chamber to form a film on the surface of the substrate with the chemical reaction, radicals-producing means which excites the cleaning gas and produces radicals, and cleaning-gas introducing means which introduces the cleaning gas containing the radicals into the film-forming chamber. The apparatus is improved by the cleaning-gas introducing means communicating directly with the film-forming chamber.

## SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to provide a plasma film-forming apparatus and a cleaning method wherein the dissipation of the radicals to be introduced into the film-forming chamber can be prevented.

Another object of this invention is to provide a plasma film-forming apparatus and a cleaning method wherein the radicals of the cleaning gas produced outside the film-forming chamber, can be effectively used for cleaning the film-forming chamber.

In accordance with one aspect of the invention, a plasma film-forming apparatus is provided which includes a film-forming chamber in which a substrate is arranged, a film-forming gas introducing pipe is connected to a supply source of a film-forming gas at its first end, a shower plate having numerous holes through which a second end of said film-forming gas introducing pipe communicates with said film-forming chamber, film-gas exciting means for exciting film-forming gas introduced through said shower plate into said film-forming chamber, to form a film on the surface of said substrate with a chemical reaction, radicals-producing means which excites said cleaning gas and produces radicals, and cleaning-gas introducing means which introduces said cleaning gas containing said radicals into said film-forming chamber, and the improvement resides in said cleaning-gas introducing means communicating directly with said film-forming chamber.

In accordance with another aspect of the invention, a cleaning method for a plasma film-forming apparatus is provided which, in the film-forming operation, introduces a film-forming gas through a shower plate having numerous holes into a film-forming chamber, excites the introduced gas and forms a film, with a chemical reaction, on a surface of substrate arranged in said film-forming chamber, and in the cleaning operation, introduces a cleaning-gas

containing radicals produced by exciting of said cleaning-gas into said film-forming chamber and cleans said film-forming chamber by chemical reaction of said radicals and removes materials to be cleaned, and the improvement resides in said cleaning gas containing said radicals being introduced directly into said film-forming chamber.

1. (Amended) In a plasma film-forming apparatus which includes a film-forming chamber in which a substrate is arranged, a film-forming gas introducing pipe connected to a supply source of a film-forming gas at a first end thereof, a shower plate having numerous holes through which a second end of said film-forming gas introducing pipe communicates with said film-forming chamber, film-gas exciting means for exciting film-forming gas introduced through said shower plate into said film-forming chamber to form a film on the surface of said substrate with a chemical reaction, radicals-producing means which excites a cleaning gas and produces radicals, and cleaning-gas introducing means for introducing said cleaning gas containing said free radicals into said film-forming chamber, the improvement comprising said cleaning-gas introducing means communicating directly with said film-forming chamber.

2. (Amended) A plasma film-forming apparatus according to claim 1, in which said cleaning-gas introducing means comprises a first cleaning-gas introducing pipe, communicating with said film-forming chamber from one of two opposite walls of said chamber, and a second cleaning-gas introducing pipe communicating with said film-forming chamber from the other of the opposite walls, and said first and second cleaning-gas introducing pipes are offset from the centers of said walls in opposite directions.

3. (Amended) A plasma film-forming apparatus according to claim 1 or 2 in which the inside surface of said cleaning-gas introducing means is coated with polytetra fluoro ethylene.

4. (Amended) In a cleaning method for a plasma film-forming apparatus which, in a film-forming operation, introduces a film-forming gas through a shower plate having numerous holes into a film-forming chamber, excites the introduced gas and forms a film with the chemical reaction on a surface of a substrate arranged in said film-forming chamber, and in a cleaning operation, introduces a cleaning-gas containing radicals produced by exciting said cleaning-gas into said film-forming chamber and cleans said film-forming chamber by chemical reaction of

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said radicals and removes materials to be cleaned, the improvement comprising introducing said cleaning gas containing said radicals directly into said film-forming chamber.

5. (Amended) A cleaning method for a plasma film-forming chamber according to claim 4, including in said cleaning operation, introducing inert gas into said film-forming chamber in addition to said cleaning gas containing radicals, exciting said inert gas to inert ions, and cleaning said film-forming chamber with the chemical reaction of said radicals and with the sputtering of said inert gas ions.

#### REMARKS

The aforesgoing amendments to the specification and the claims correct indefinite terminology and grammatical errors. These amendments are considered to place the application in better condition for examination purposes and early allowance.

Respectfully submitted,

CAROTHERS AND CAROTHERS



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**APPENDIX: MARKED UP VERSION OF AMENDMENTS**  
**TO THE SPECIFICATION AND CLAIMS**

**ABSTRACT OF THE DISCLOSURE**

[In a] A plasma film-forming apparatus which includes a film-forming chamber in which a substrate is arranged, a film-forming gas introducing pipe is connected to a supply source of a film-forming gas at its first end, a shower plate [through] having numerous holes [of] through which a second end of [said] the film-forming gas introducing pipe [communicate] communicates with [said] the film-forming chamber, film-gas exciting means for exciting film-forming gas introduced through [said] the shower plate into [said] the film-forming[,] chamber to form a film on the surface of [said] the substrate with the chemical reaction, radicals-producing means which excites [said] the cleaning gas and produces radicals, and cleaning-gas introducing means which introduces [said] the cleaning gas containing [said] the radicals into [said] the film-forming chamber[, the improvement in which said]. The apparatus is improved by the cleaning-gas introducing means [communicate] communicating directly with [said] the film-forming chamber.

## SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to provide a plasma film-forming apparatus and [the] a cleaning method [that] wherein the dissipation of the radicals to be introduced into the film-forming chamber can be prevented.

Another object of this invention is to provide a plasma film-forming apparatus and [the] a cleaning method [that] wherein the radicals [as] of the cleaning gas produced outside the film-forming chamber, can be effectively used for cleaning the film-forming chamber.

In accordance with one aspect of the invention, [in] a plasma film-forming apparatus is provided which includes a film-forming chamber in which a substrate is arranged, a film-forming gas introducing pipe is connected to a supply source of a film-forming gas at its first end, a shower plate [through] having numerous holes [of] through which a second end of said film-forming gas introducing pipe [communicate] communicates with said film-forming chamber, film-gas exciting means for exciting film-forming gas introduced through said shower plate into said film-forming chamber, to form a film on the surface of said substrate with [the] a chemical reaction, radicals-producing means which excites aid cleaning gas and produces radicals, and cleaning-gas introducing means which introduces said cleaning gas containing said radicals into said film-forming chamber, and the improvement resides in [which] said cleaning-gas introducing means [communicate] communicating directly with said film-forming chamber. [film-forming chamber.]

In accordance with another aspect of the invention, [in] a cleaning method [of] for a plasma film-forming apparatus is provided which, in the film-forming operation, introduces a film-forming gas through a shower plate having numerous holes into a film-forming chamber, excites the introduced gas and forms a film, with [the] a chemical reaction, on a surface of

substrate arranged in said film-forming chamber, and in the cleaning operation, introduces a cleaning-gas containing radicals produced by exciting of said cleaning-gas[,] into said film-forming chamber and cleans said film-forming chamber by chemical reaction of said radicals and removes materials to be cleaned, and the improvement resides in [which] said cleaning gas containing said radicals [is] being introduced directly into said film-forming chamber.

100 90 80 70 60 50 40 30 20 10

1. (Amended) In a plasma film-forming apparatus which includes a film-forming chamber in which a substrate is arranged, a film-forming gas introducing pipe connected to a supply source of a film-forming gas at [its] a first end thereof, a shower plate [through] having numerous holes [of] through which a second end of said film-forming gas introducing pipe [communicate] communicates with said film-forming chamber, film-gas exciting means for exciting film-forming gas introduced through said shower plate into said film-forming chamber to form a film on the surface of said substrate with [the] a chemical reaction, radicals-producing means which excites [said] a cleaning gas and produces radicals, and cleaning-gas introducing means [which introduces] for introducing said cleaning gas containing said free radicals into said film-forming chamber, the improvement [in which] comprising said cleaning-gas introducing means [communicate] communicating directly with said film-forming chamber.

2. (Amended) A plasma film-forming apparatus according to claim 1, in which said cleaning-gas introducing means comprises a first cleaning-gas introducing pipe, communicating with said film-forming chamber from one of [the] two opposite walls of said chamber, and a second cleaning-gas introducing pipe communicating with said film-forming chamber from the other of the opposite walls, and said first and second cleaning-gas introducing pipes are [shifted] offset from the centers of said walls in opposite directions.

3. (Amended) A plasma film-forming apparatus according to claim 1 or 2 in which the inside surface of said cleaning-gas introducing means is coated with polytetra fluoro ethylene.

4. (Amended) In a cleaning method [of] for a plasma film-forming apparatus which, in [the] a film-forming operation, introduces a film-forming gas through a shower plate having numerous holes into a film-forming chamber, excites the introduced gas and forms a film[,] with the chemical reaction[,] on a surface of a substrate arranged in said film-forming chamber, and in [the] a cleaning operation, introduces a cleaning-gas containing radicals produced by exciting

[of] said cleaning-gas[,] into said film-forming chamber and cleans said film-forming chamber by chemical reaction of said radicals and removes materials to be cleaned, the improvement [in which] comprising introducing said cleaning gas containing said radicals [is introduced] directly into said film-forming chamber.

5. (Amended) A cleaning method [of] for a plasma film-forming chamber according to claim 4, [in which,] including in said cleaning operation, introducing inert gas [is introduced] into said film-forming chamber [besides] in addition to said cleaning gas containing radicals, exciting said inert gas [is excited] to [be] inert ions, and cleaning said film-forming chamber [is cleaned] with the chemical reaction of said radicals and with the sputtering of said inert gas ions.